

CLAIMS

1. A tunable laser, comprising:

a multiple ring resonator in which a plurality of ring resonators, which are constituted with ring-type waveguides having optical path lengths different from each other, are
5 coupled through an optical-coupling device;

an LD-side waveguide whose one end is connected to one of the plurality of ring resonators through an optical-coupling device;

a reflection-side waveguide whose one end is connected
10 to other one of the plurality of ring resonators through an optical-coupling device;

a single board on which the ring resonator, the LD-side waveguide and the reflection-side waveguide are formed;

a reflection film provided to other end of the
15 reflection-side waveguide;

a laser diode chip having a low reflection film formed on one of two opposing emission end faces, which is optically coupled to the LD-side waveguide through the low reflection film; and

20 a tuning device for changing resonance wavelength of the multiple ring resonator.

2. The tunable laser as claimed in claim 1, wherein the multiple ring resonator contains at least two or more of the

ring resonators.

3. The tunable laser as claimed in claim 1, wherein the low reflection film of the laser diode chip is abutted against the LD-side waveguide to be optically coupled.

4. The tunable laser as claimed in claim 1, wherein the low reflection film of the laser diode chip is optically coupled to the LD-side waveguide through an optical device.

5. The tunable laser as claimed in claim 4, wherein a lens is used as the optical device.

6. The tunable laser as claimed in claim 1, wherein, in the plurality of ring resonators, diameters of the ring waveguides are set so that intervals of reflection peaks appearing periodically become different, and there generates
5 resonance at a meeting point of the reflection peaks.

7. The tunable laser as claimed in claim 1, wherein directional couplers are used as the optical-coupling devices.

8. The tunable laser as claimed in claim 1, wherein the tuning device changes refractive indexes of the ring-type waveguides of the ring resonators for changing resonance wavelength.

9. The tunable laser as claimed in claim 7, wherein the tuning device changes the refractive indexes of the ring-type waveguides by utilizing temperature properties of the ring-type waveguides.

10. The tunable laser as claimed in claim 1, further comprising a wavelength detecting device for detecting resonance wavelength of the multiple ring resonator.

11. The tunable laser as claimed in claim 9, wherein the wavelength detecting device lets through or shields light of only a specific range of wavelengths to detect the wavelength.

12. The tunable laser as claimed in claim 10, comprising a control device for feedback-controlling resonance of the multiple ring resonator based on resonance wavelength information detected by the wavelength detecting device.

13. The tunable laser as claimed in claim 1, wherein a stray light suppressing part for suppressing influence of a stray light that is emitted from an end face extended from one end of the LD-side waveguide or an end face extended from one
5 end of the reflection-side waveguide is provided.

14. The tunable laser as claimed in claim 1, wherein a

filter for letting through light of only a specific range of wavelengths is inserted at least to one place selected from the LD-side waveguide between the multiple ring resonator and the laser diode chip, the reflection-side waveguide between the multiple ring resonator and the high reflection film, and between the ring resonators.

15. The tunable laser as claimed in claim 1, wherein a light-receiving element is provided to an end face that is extended from one end of the LD-side waveguide or an end face that is extended from one end of the reflection-side waveguide.

16. The tunable laser as claimed in claim 1, wherein the laser diode chip is mounted on the board by a passive alignment technique.

17. The tunable laser as claimed in claim 15, wherein the light-receiving element is mounted on the board by a passive alignment technique.